

A new coelacanth from the Early Cretaceous of Brazil (Sarcopterygii, Actinistia)

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Abstract. A new coelacanth fish of the genus *Mawsonia*, *M. brasiliensis* sp. nov. is described on the basis of a specimen from the Early Cretaceous Romualdo Member of the Santana Formation in the Araripe Plateau, Brazil. This is the third species of coelacanth from the Cretaceous of Brazil and the holotype is the first complete, articulated specimen of the genus. This new species differs from its congeners in the proportion of the cranium, gular plates and angular, and the position of the otic canal fossa. *M. brasiliensis* has thin cycloid scales without ornament (no tubercles or ridges). This new addition to the genus *Mawsonia* is significant in increasing understanding of the diversity of the suborder Latimeroidei in the early Cretaceous, which lineage continues to the Recent coelacanths of the genus *Latimeria*.

Key words: Araripe, Brazil, coelacanth, Early Cretaceous, *Mawsonia*, new species, Santana Formation

Introduction

The Araripe Plateau, northeastern Brazil, is well known for its excellently preserved Early Cretaceous shallow marine and freshwater fossil assemblages (Maisey, 1991; Martill, 1993; Evans and Yabumoto, 1998). Two coelacanth species have been described from Cretaceous deposits in Brazil: *Mawsonia gigas* Woodward, 1907 from the Neocomian of Bahia, and *Axelrodichthys araripensis* Maisey, 1986 from the Romualdo Member of the Santana Formation. On the basis of an almost complete articulated specimen recovered from the Romualdo Member of the Santana Formation, Araripe Plateau, Brazil, a new species of the genus *Mawsonia* is proposed. An almost complete neurocranium and some other disarticulated head bones from the Romualdo Member that Maisey (1986) described as *M. cf. gigas* are referable to this new species. This new addition to the genus *Mawsonia* is significant in increasing understanding of the diversity of the suborder Latimeroidei in the early Cretaceous, which lineage continues to the Recent forms of coelacanths of the genus *Latimeria*. Figures were made using a camera lucida. Terminology of coelacanth bones follows Forey (1998) and of median fins follows Uyeno (1991).

Systematic description

Order Coelacanthiformes Huxley, 1861
Suborder Latimeroidei Schultz, 1993
Family Mawsoniidae Schultz, 1993
Genus *Mawsonia* Woodward, 1907

Mawsonia brasiliensis sp. nov.

Figures 1–4

Mawsonia cf. gigas Maisey, 1986, p. 3–13, figs. 1–11; Maisey, 1991, p. 317–323.

Material.—KMNH (Kitakyushu Museum of Natural History and Human History) VP 100,247, holotype, an almost complete, articulated specimen preserved in a calcareous concretion.

Type locality.—Exact locality not recorded, Araripe Plateau, Brazil. The type horizon is probably the Romualdo Member of the Santana Formation, which has yielded many fish fossils preserved in the same type of calcareous concretions as was the holotype. Although the age of this formation is considered to be Cretaceous, there are different opinions as to its exact age—Aptian (Santos and Valenca, 1968), Albian (Lima, 1979), Aptian-Albian (Schobbenhaus and Campos, 1986), older Neocomian (Maisey, 1986), Aptian-Albian (Maisey, 1991) and early Cenomanian (Martill, 1990).



Figure 1. *Mawsonia brasiliensis* sp. nov., holotype (KMNH VP 100.247, 1277 mm SL) from the Romualdo Member of the Santana Formation in the Araripe Plateau, Brazil.

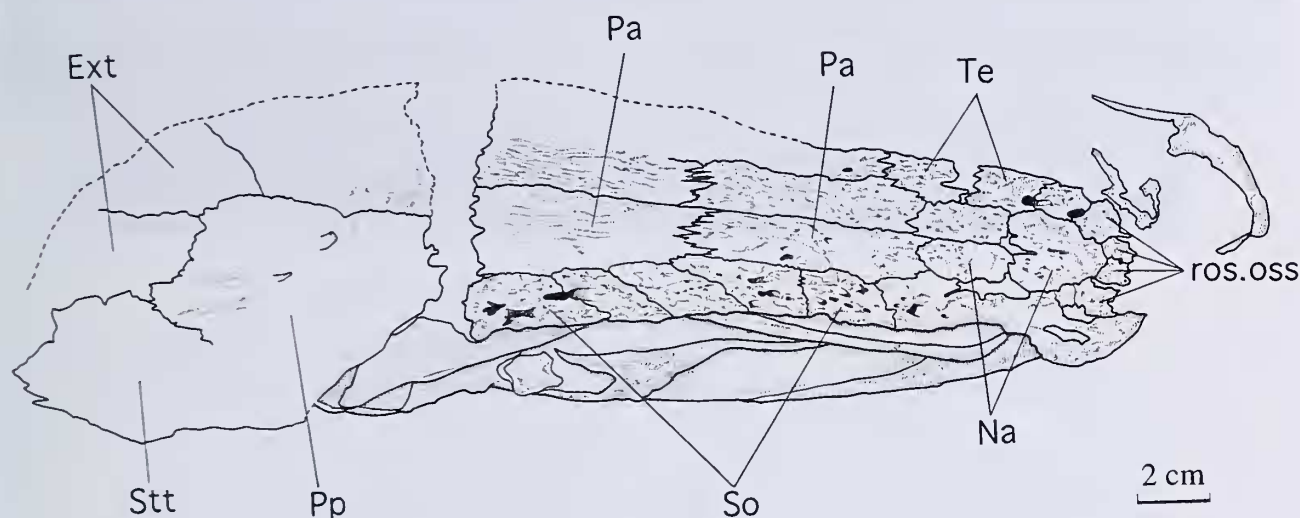


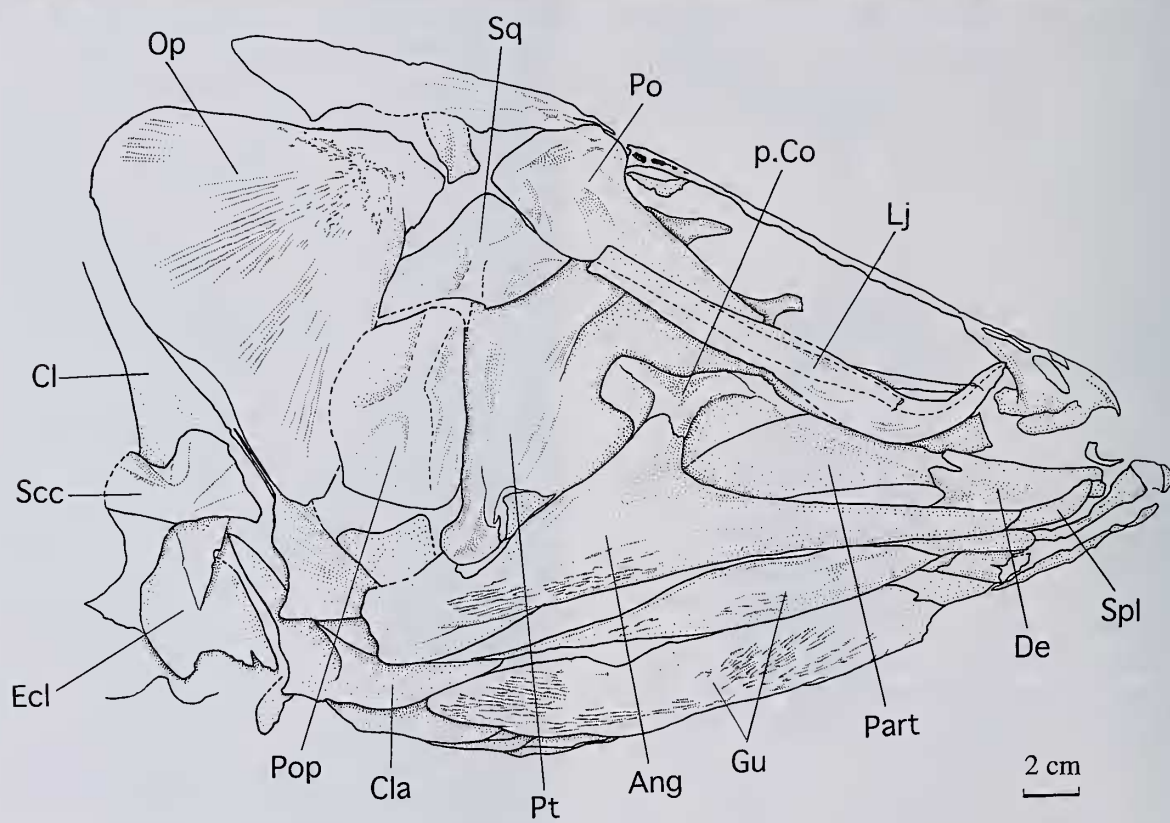
Figure 2. *Mawsonia brasiliensis* sp. nov., skull in dorsal view, holotype (KMNH VP 100,247, 1277 mm SL) from the Romualdo Member of the Santana Formation in the Araripe Plateau, Brazil. Abbreviations: Ext = extrascapular; Na = nasal; Pa = parietal; Pp = postparietal; ros.oss = rostral ossicles; So = supraorbital; Stt = supratemporal; Te = tectal.

Etymology.—The species is named for the country in which the specimen was found.

Diagnosis.—Length of the parietonasal shield is about twice its width. Its size is about 1.5 times that of the postparietal shield. Width of the postparietal shield is about 1.2 times its length. The fossa for the otic canal (foc) is present on the lateral surface of the postparietal and close to the small anterior apophysis (apa). The oval gular plate has no ridge running from the anterior to posterior ends. The ridges on the operculum are radial and weak. The angular is deep at its posterior, steep at the posterior dorsal edge, narrow at its anterior, and its anterior dorsal margin (where it articulates with the principal coronoid and

prearticular) is deeply concave. The scales are thin and have fine bony ridges (circuli) on the exposed portion, but have no ornamental tubercles or ridges typical of coelacanths.

Description of holotype.—The body is slender; body depth at the origin of the first dorsal about 300 mm; total length 1435 mm; standard length 1277 mm; head length 375 mm. Length of the parietonasal shield is 185.6 mm, the posterior end being broader, width of the right half 43.1 mm. Both parietals are narrow, the posterior one is wider, but the anterior one is just a bit longer. There is one anterior nasal, possibly fused, which is almost the same width as the width of the posterior nasals. The paired posterior



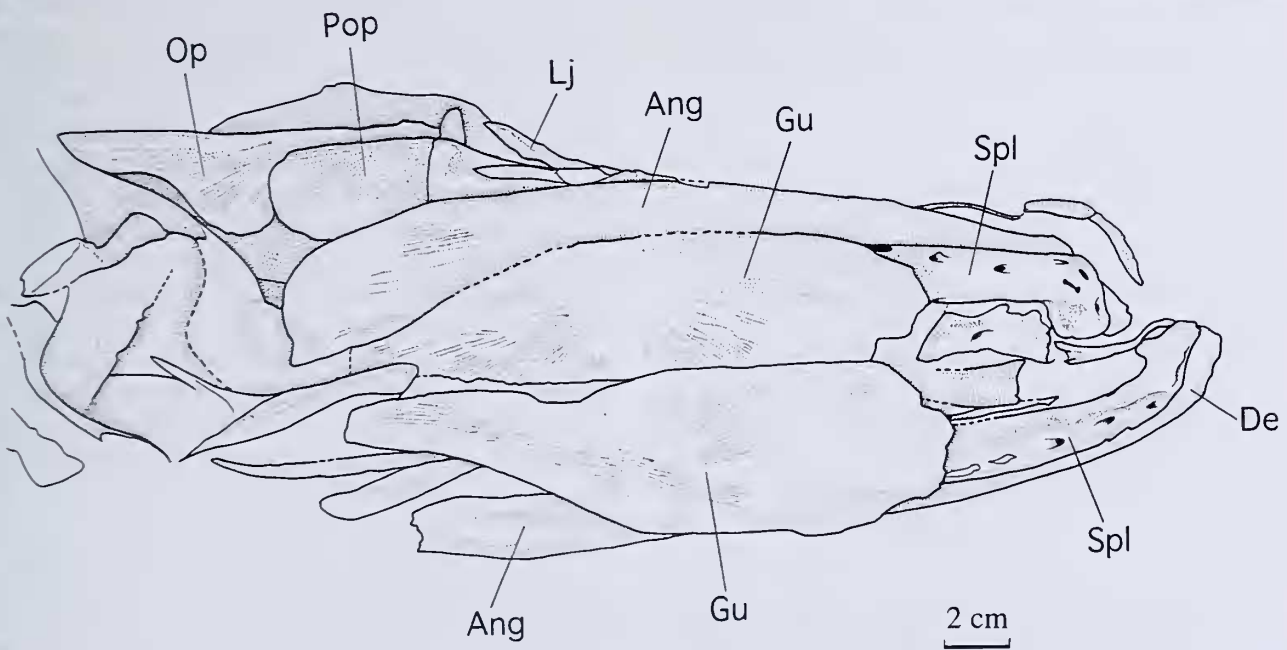


Figure 4. *Mawsonia brasiliensis* sp. nov., skull in ventral view, holotype (KMNH VP 100,247) from the Romualdo Member of the Santana Formation in the Araripe Plateau, Brazil. Abbreviations: Ang = angular; De = dentary; Gu = gular plate; Lj = lachrymojugal; Op = operculum; Pop = preoperculum; Spl = splenial.

← Figure 3. *Mawsonia brasiliensis* sp. nov., skull in lateral view, holotype (KMNH VP 100,247) from the Romualdo Member of the Santana Formation in the Araripe Plateau, Brazil. Abbreviations: Ang = angular; Cl = cleithrum; Cla = clavicle; De = dentary; Ecl = extracleithrum; Gu = gular plate; Lj = lachrymojugal; Op = operculum; Part = prearticular; p. Co = principal coronoid; Po = postorbital; Pop = preoperculum; Pt = pterygoid; Scc = scapulocoracoid; Spl = splenial; Sq = squamosal.

nasals are short, about 40% the length of the anterior parietals, and about 2.5 times their own width.

The paired posterior and anterior tectals are separated by a small space and are almost the same size, 22.5 mm in length and 16 mm in width. While the left tectals are well preserved, the right pair are slightly broken. The anterior tectal suture has posterior and anterior nasals and posterior rostral ossicles, while the posterior tectal suture has anterior parietals and posterior nasals. Each anterior tectal has a foramen which opens forward.

There are three pairs of rostral ossicles, all attached to the anterior nostril. While the anterior ossicles are small, 10.1 mm in length, 5.9 mm in width, the posterior and middle rostral ossicles are almost the same size: posterior pair 17.8 mm in length, 12.5 mm in width; middle pair 18.2 mm in length, 14.5 mm in width. There is a relatively large foramen, 5.2 mm long, between the posterior and middle rostral ossicles. The middle rostral ossicles also possess a foramen. There is a groove between the middle and anterior rostral ossicles.

Four supraorbitals are present, all about the same width. While the outline of the left supraorbitals is not distinct because the surface is broken, the right ones are well preserved. The length of the most anterior supraorbital is longest, 67.0 mm, about 1.5 times that of the others. Each supraorbital possesses a small foramen. Most of the first supraorbital attaches to the anterior parietal, but the posterior end attaches to the posterior parietal. The other supraorbitals attach to the posterior parietal.

The postparietal shield consists of a pair of postparietals, supratemporals and extrascapulars, the middle extrascapular being absent. Although most of the postparietals are broken, the suture between each bone can be recognized, except for the portion between the postparietal and supratemporal. About half of the left side and half of the right surface of the postparietal shield are missing. Of this shield, the postparietal, with two short processes on the anterior ventral surface, is the largest bone with a length of 76.7 mm. The width of the right extrascapular is 30.1 mm.

All cheekbones are well preserved. The postorbital, with a length of 119.2 mm and a height of 54.1 mm, has a long anterior process ventrally, extending 71.7 mm to the middle of the lachrymojugal. The depth at the base of the process is 21.1 mm. While the upper edge of the squamosal at 36.7 mm width is almost twice that of the lower edge, the depth is 53.8 mm. The preoperculum is deep, with a depth of 62.2 mm, about 1.5 times the width (44.5 mm). It is also narrow and round at the upper margin and along the lower margin of the squamosal. A sensory canal forks into two at the center of the preoperculum. The lachrymojugal is 149.1 mm long. Its anterior end curves upward, and a sensory canal runs along the upper

margin of this curved part.

The mentomeckelian is short, 42.2 mm in length, thick (13.7 mm) at the anterior end, and thin (2.8 mm) at its posterior.

The dentary lies outside the mentomeckelian and the lateral swelling is absent. It is long (left dentary 140.6 mm), almost half that of the mandible, curves medially at the anterior part, and the surface overlapping the angular is long. The upper limb of the dentary (81.7 mm in length) is short and contacts the prearticular, while the lower limb is long and occupies almost half of the mandible. There are two tooth plates on the dentary, but even though all the teeth are missing, many alveoli are visible, a few are 1 mm deep, and the rest of them minute.

The angular is long (from the anterior end of the inside to the posterior end of the outside, 149.2 mm), its deepest part is slightly behind the middle of the mandible, and at this point, the suture has a principal coronoid, forming a dorso-anterior process. Anterior to this point, it abruptly narrows, while posteriorly it gradually narrows, its depth posteriorly being almost twice that at the anterior.

The 72.2 mm long principal coronoid consists of anterior and posterior portions separated by a narrow section (24.3 mm deep) at the middle where the suture has the angular. The anterior portion has an almost triangular shape, and its antero-ventral margin contacts the prearticular. The posterior portion is rectangular with a depth of 16.9 mm and a length of 26.0 mm from the narrow section. The dorsal part of the posterior portion also forms a ridge that continues to the angular.

The anterior portion of the prearticular joins with the dentary and angular on the distal surface of the jaw to form a large foramen, while its posterior portion contacts the angular ventrally and the principal coronoid dorsally. Its deepest part, at 26.2 mm, is just behind the lateral midpoint.

The articular is small, 16.8 mm in depth, 24.4 mm long, and separated from the retroarticular. It joins with the retroarticular ossification to form glenoid articulation with a quadrate.

The right splenial is well preserved, its length about 5 times the width, and has five sensory canal openings. It contacts the ventro-mesial face of the dentary, and its anterior end curves mesially. While the width of the anterior end is 20.6 mm and the length 93.6 mm, the posterior portion gradually broadens to 18.8 mm.

The pterygoid, quadrate, and metapterygoid (including the anterior portion of the articular surface for the antotic surface) are exposed, but the pterygoid is covered for the most part by the lachrymojugal and lower jaw. Also, the border between the pterygoid and metapterygoid is covered by the postorbital and lachrymojugal. The quadrate has a slightly twisted upper portion, and articulates with the lower jaw by condyles the distal one of which is exposed.

There is a short dorso-anterior process on the upper end of the metapterygoid.

The cleithrum, extracleithrum and clavicle are well preserved. While the cleithrum is long and reaches up to about the level of the upper edges of the operculum, its upper portion has a cylindrical shape while its lower portion is broad and complicated in structure. Also a flange extends outward and backward at the antero-ventral portion of the cleithrum. Its triangular postero-ventral portion joins with the extracleithrum to form a postero-ventral section of the shoulder girdle. The extracleithrum is a broad bony plate and slightly curves anteriorly. The clavicle contacts the ventral edge of the cleithrum and the anterior edge of the extracleithrum. It consists of anterior and posterior flanges, the latter being narrow along the dorsal edge. The anocleithrum is not preserved in this specimen.

The scapulocoracoid, shaped like a twisted bowtie, is preserved on the cleithrum slightly below the middle of the cleithrum, and is slightly apart from extracleithrum.

The triangular operculum extends slightly antero-ventrally, while its postero-ventral margin becomes slightly concave below the middle of the margin. Its anterior margin is thick, being thickest at the dorsal end. Most of the opercular surface is missing, but weak radiating ridges are visible.

The first dorsal fin with 10 fin rays is well preserved. Its basal plate, 92.5 mm long and 40.8 mm deep, is kidney-shaped with the anterior portion slightly extended, deepest at slightly behind the midpoint, while the posterior dorsal edge supports the dorsal fin rays. The depth of the anterior end of the plate is 16.7 mm. The first five fin rays articulate with the thick edge which fans out from the portion slightly behind the center of the plate. From this portion a weak ridge runs forward.

The second dorsal fin rays are not preserved. Its basal plate has two anterior branches, the upper branch at 72.5 mm being longer and more slender than the lower (54.0 mm). The length of the preserved part is 112.9 mm. Even with the very end missing, it can be seen that the posterior portion of the basal plate is broad.

Both pectoral fins are preserved. The right pectoral fin with thirty-two countable fin rays is preserved behind the head and covers the anterior part of the basal plate of the dorsal fin. Twenty-five rays can be counted on the portion of the left pectoral fin preserved below the right pelvic girdle.

Three bones of the pelvic girdle are preserved above the middle of the left pectoral, the most anterior one being the largest and T-shaped, and consisting of three processes. The posterior end of the bone is missing. Its anterior process abruptly becomes narrow anteriorly, while the dorsal process is shorter than the ventral process, and slightly curves backward. Two small bones behind the large pel-

vic bone are considered to be axial mesomeres of the pelvic girdle. The anterior portions of the mesomeres are missing; however what remains of the ventral cylindrical one gradually thickens posteriorly. It is larger than the dorsal one. Twenty-two fin rays can be counted in the left pelvic fin. A part of the right pelvic fin is preserved on the ribs. The first anal fin is missing.

The centra are unossified. Their anterior neural spines are short and pebble-like, but the posterior ones are longer. Neural spines that articulate with pterygiophores of the third dorsal fin are long and stout at the dorsal end. The base of the neural spines is divided and forms the neural arches. There are 20 neural spines for the third dorsal pterygiophores and 33 anterior to them. Twenty-three relatively long, slender ribs are found along the dorsal margin of the swim bladder.

There are 23 third dorsal fin rays. Four haemal spines can be identified anterior to the first pterygiophore of the second anal fin. Fifteen haemal spines reach to the 21 pterygiophores of the second anal fin. The number of second anal fin rays is 25.

Only part of the caudal fin is preserved. The posterior end is missing. Four rays of the upper lobe and 7 rays of the lower lobe are preserved.

Scales are thin and well preserved, but no typical coelacanth tubercle or ridge ornamentation is visible, except for fine bony ridges (circuli) on the exposed portion.

Remarks.—Cloutier and Forey (1991) recognized the following five species in the genus *Mawsonia*: *M. gigas* Woodward, 1907, *M. tegamensis* Wenz, 1975, *M. ubangiana* Casier, 1961, *M. lavocati* Tabaste, 1963, and *M. libyca* Weiler, 1935. *M. gigas* was described from South America, the others from Africa. Maissey (1986) described the specimen AMNH 11758, acid-prepared bones: parietonasal and postparietal shields, right postorbital, squamosal, lachrymojugal, incomplete operculum, pterygoid, metapterygoid, quadrate, autopalatine, and coronoid from a single specimen as *M. cf. gigas*. The author compared the present specimen with specimen AMNH 11758 and now regards it as *M. brasiliensis*, because the proportions of these bones are the same. The specimen AMNH 11758 has the fossa for the otic canal of the postparietal on the lateral surface of the postparietal close to the anterior apophysis.

On the basis of the following characters, this new species belongs to the genus *Mawsonia*: length of the parietonasal shield is about 1.5 times the length of the postparietal shield, postorbital (dermosphenotic in Maissey, 1986) has a splint-like anterior projection, posterior two-thirds of the elongated lachrymojugal is almost straight.

This new species differs from *M. tegamensis* from the Aptian of Niger in having the length of the parietonasal shield twice (versus 1.7 times) its width and 1.5 times (ver-

sus 1.4 times) the length of the postparietal shield; width of the postparietal shield 1.2 times (versus 1.6 times) its length; long, oval gular plates versus gular plates with a wide, rather than slender, anterior portion; radial ornamentation on the anterior portion of the operculum versus a mesh-like pattern.

This new species differs from *M. ubangiana* from the Neocomian of Zaire in having the fossa for the otic canal of the postparietal (parietal in Maisey, 1986) on the lateral surface of the postparietal close to the anterior apophysis. In *M. ubangiana*, the fossa is present on the ventral surface of the postparietal distant from the anterior apophysis of the postparietal.

In *M. lavocati* from the Albian of Morocco, the anterior end of the angular is higher than that of the new species, and the angle between the postero-dorsal edge and the ventral edge of the angular is larger. Also, the ornamentation in *M. lavocati* is more pronounced.

This new species differs from *M. libyca* from the Albian of Egypt in having the dorsal edge of the angular deeply concave at the midpoint versus slightly concave.

Although this new species is close to *M. gigas* from the Neocomian of Bahia, Brazil in appearance, it differs in having the small anterior apophysis of the postparietal and the fossa for the otic canal close to the anterior apophysis versus a large anterior apophysis of the postparietal and the fossa for the otic canal distant from the anterior apophysis of the postparietal; the antero-lateral surface of the postparietal forming a steep (versus gentle) slope; the angular being deeper; and no ridge running from the anterior to posterior ends on the gular plates.

This new addition to the genus *Mawsonia* is significant in increasing understanding of the diversity of the suborder Latimerioidei in the early Cretaceous, which lineage continues to the Recent coelacanths of the genus *Latimeria*.

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